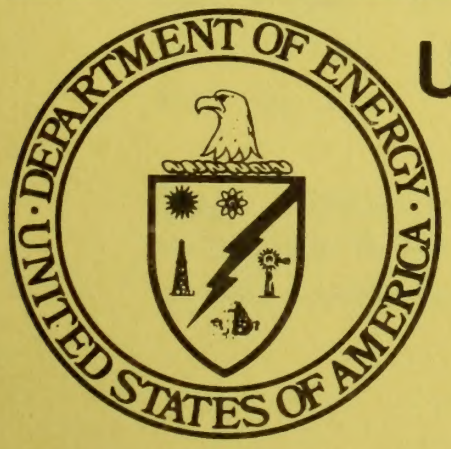
SOLAR/2014-79/04

Monthly Performance Report

BLAKEDALE PROFESSIONAL CENTER

APRIL 1979



U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT
BLAKEDALE PROFESSIONAL CENTER
APRIL 1979

I. SYSTEM DESCRIPTION

The Blakedale Professional Center solar energy system is designed to provide 85 percent of the space heating requirements and 100 percent of the domestic hot water heating requirements for a 4,400 square foot office suite in Greenwood, South Carolina. Solar energy is collected by 53 flat-plate collectors, which are manufactured by PPG Industries. The collectors, having a gross area of 954 square feet, are arranged in three banks and are mounted on the roof. Each collector array faces south at an angle of 45 degrees from the horizontal. The heat transfer medium is 99 percent water and one percent corrosion inhibitor. Solar energy is stored in a 5,000-gallon tank that is buried under the parking lot. The tank is insulated with four inches of sprayed-on polyurethane which is covered with a waterproof coating. When solar energy is inadequate, auxiliary space heating is provided by a 10-ton heat pump and a 36-kilowatt electric resistance heater. Auxiliary hot water heating is provided by an electrical element in a 40-gallon tank. Freeze protection is provided by a drain-down system.

The system, shown schematically in Figure 1, has four modes of operation:

Mode 1 - Collector-to-Storage: This mode is entered when the difference between the temperature of the collector and the temperature of water near the bottom of the water thermal storage is greater than 19°F. Pump P1 circulates water through the collectors to transfer solar energy to the water thermal storage. This mode terminates when the temperature differential is less than 6°F, or the temperature of water in the collector is less than 37°F.

Mode 2 - Storage-to-Office Area (Solar): This mode is entered when heat is required in the office area. Pump P2 circulates water through the water thermal storage to heat exchanger HX2 in the air-handling unit. This mode

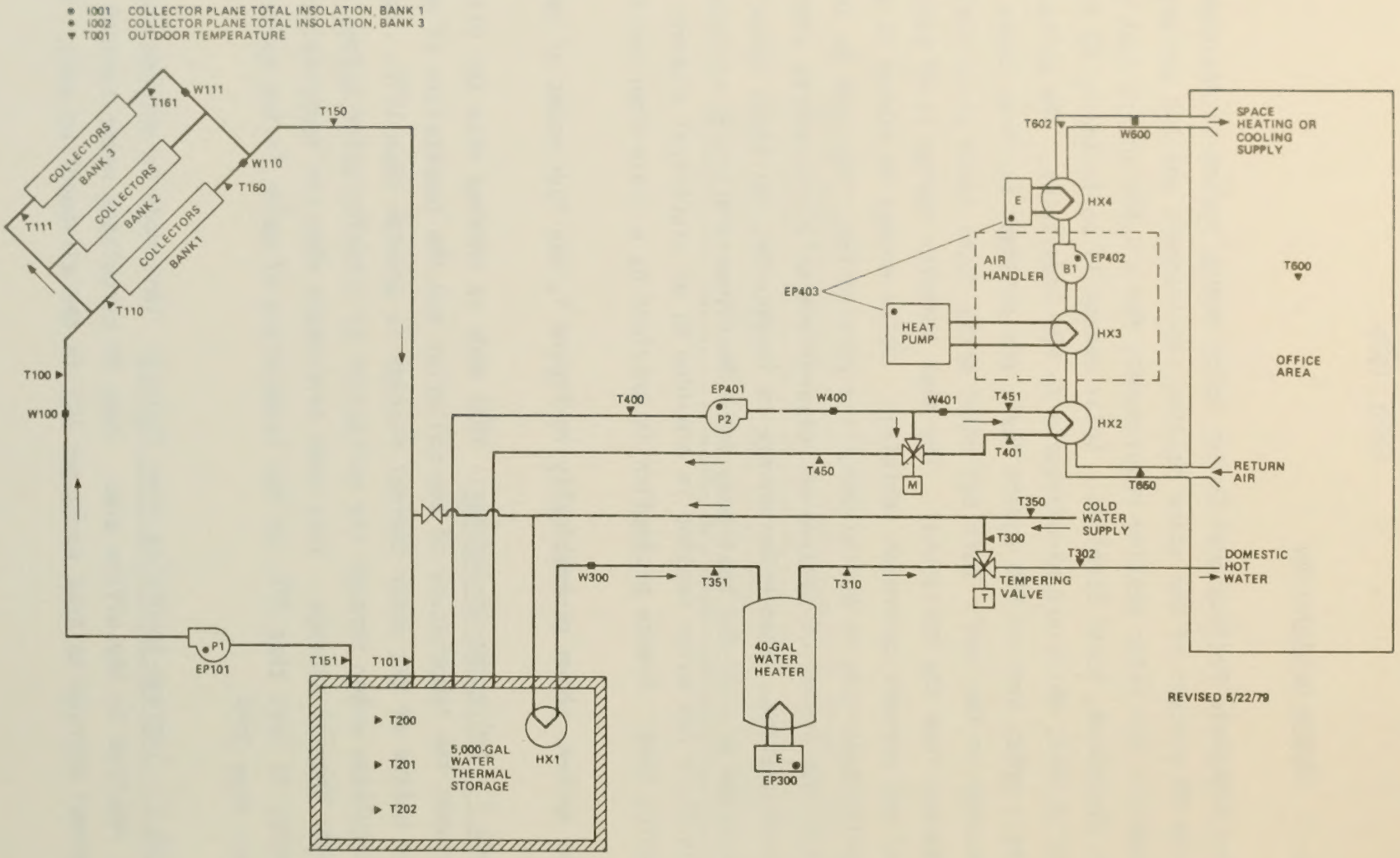


Figure 1. BLAKEDALE PROFESSIONAL CENTER SOLAR ENERGY SYSTEM SCHEMATIC

terminates when the supply air temperature is greater than 120°F, as the circulation bypasses this heat exchanger by the action of the motorized valve, or the requirement for heat is satisfied.

Mode 3 - Storage-to-Office Area (Auxiliary): Although this mode is not a solar mode of operation, it is entered concurrently with Mode 2 when heat is required in the office and the office return air temperature is less than 65°F. A 10-ton heat pump is energized to provide thermal energy to heat exchanger HX3. When the outside air temperature is less than 40°F, two 18-kilowatt electric resistance heaters are energized in stages to provide auxiliary energy to heat exchanger HX4. This mode terminates when the office return air temperature is greater than 68°F, or the requirement for heat is satisfied.

Mode 4 - Domestic Hot Water Preheating: This mode is entered when there is a requirement for hot water. As hot water is drawn, cold water passes through heat exchanger HX1 in the water thermal storage, and subsequently through the water heater and tempering valve to provide 120°F water. This mode terminates when the requirement for hot water is satisfied.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The Blakedale Professional Center solar energy system was operational for the first 20 days in April. After April 20, the solar energy system was

shut down for the summer as the heating season was essentially completed. There were some minor space heating requirements after April 20 but these were satisfied by the heat pump auxiliary system.

Since the solar energy system did not operate after April 20, some of the daily averages presented in the attached computer generated monthly report will be in error. This is because the daily averages are based on the full 30-day month, rather than the fraction of the month that the solar energy system was operational. The daily averages that will be affected are those that primarily relate to the operation of the solar energy system. These would include such things as solar energy collected, collector array efficiency, various operating energies, most of the storage subsystem parameters and all space heating subsystem parameters that are based on some solar energy contribution.

During April, the solar energy system satisifed 52 percent of the total space heating load. However, the solar fraction was 58 percent for the first 20 days of the month. The net electrical energy savings for the space heating subsystem were 0.10 million Btu, but, overall, the system operated at a net loss of 0.13 million Btu for the month.

During April, there were some control system problems that resulted in anomalous operation of the pumps (P1 and P2) in the solar energy system. These problems were discussed in detail in the March report, and they result essentially in an unnecessary waste of both solar and auxiliary energy. Unscheduled operation of pump P1 resulted in 0.23 million Btu of solar energy being removed from storage and lost through transport losses or by rejection from the collector array. During periods when the solar portion of the space heating subsystem was operating (9 of the first 20 days in the month), excessive operation of pump P2 caused an excess consumption of 0.40 million Btu of operating energy and a loss of approximately 0.75 million Btu of solar energy.

B. Weather

During April, the measured average outside ambient temperature was 66°F. This was four degrees above the long-term average ambient temperature of 62°F and reduced the building heating load. The measured value for insolation incident in the plane of the collector array was 1,424 Btu/ft^2-day, and this was 12 percent below the long-term average of 1,625 Btu/ft^2-day. Long-term average temperature data and long-term average insolation data are taken from Reference Monthly Environmental Data for Systems in the National Solar Data Network, Department of Energy Report SOLAR/0019-79/36.

C. System Thermal Performance

Collector - During the reporting period, a total of 40.76 million Btu of incident solar energy was measured in the plane of the collector array. The system collected a net amount of 6.42 million Btu, or 16 percent of the total available insolation. During the time when the system was operating, a total of 22.29 million Btu of solar energy was incident on the array. This represents an operational collector efficiency of 29 percent. A total of 0.23 million Btu of electrical energy was required to operate the collector array. However, part of this operating energy expenditure was due to unscheduled operation of pump P1, and this allowed 0.23 million Btu of stored solar energy to be rejected from the collector array to the atmosphere.

Storage - During April, a total of 6.60 million Btu was delivered to the storage tank. However, the unscheduled operation of pump P1 caused 0.60 million Btu to be removed from storage and lost, either through the collector array (0.23 million Btu) or the system piping (0.37 million Btu). Therefore, there was a net amount of 6.00 million Btu delivered to storage during the month.

A total of 2.62 million Btu was removed from storage during the reporting period. Since 1.85 million Btu was actually delivered to the space heating subsystem, there were 0.77 million Btu in transport losses. The significant point regarding these transport losses is that the majority of them (0.75 million Btu) resulted from the excessive operation of pump P2.

The change in stored energy was 0.21 million Btu and this, combined with the energy supplied to and removed from storage, resulted in a thermal loss from storage of 3.17 million Btu. Storage was maintained at an average temperature of 118°F, and the monthly storage efficiency was 0.47.

Hot Water Load - The hot water load at the Blakedale Professional Center is very small. The make-up water is heated by the storage tank and the electrical auxiliary system is not used. Therefore, although the solar energy system carries the entire hot water load, this load is small enough to be neglected.

Space Heating Load - The space heating load for April was 3.55 million Btu. However, this value represents the load for the entire month. During the period when the solar energy system was active, the total space heating load was 3.17 million Btu and solar energy satisfied 1.85 million Btu or 58 percent of this load. The remainder of the energy required for space heating was delivered by the heat pump.

As noted in the storage section, 0.75 million Btu of solar energy were wasted by the space heating subsystem due to excessive operation of pump P2. This represents 41 percent of the total amount of solar energy that was delivered to the space heating load.

During April, the total amount of energy delivered to the space heating subsystem maintained an average building temperature of 73°F. The average outdoor ambient temperature was 66°F.

D. Observations

The April operation of the Blakedale Professional Center solar energy system was somewhat degraded due to the control problems previously discussed. This installation has a relatively large energy collection and storage subsystem (ECSS), when compared to the actual size of the building, and a higher level of performance should be expected from this solar energy system.

E. Energy Savings

During April, the space heating subsystem realized a net savings of only 0.10 million Btu. However, when the 0.23 million Btu of electrical energy required to operate the ECSS is considered, then the overall system actually operated at a loss of 0.13 million Btu for the month. Part of this loss was due to the unscheduled operation of pump P1, but the majority of the loss came from the excessive operation of pump P2. This pump consumed 0.40 million Btu of electrical energy by operating during periods when no solar energy was being supplied to the space heating subsystem. If the system had been operating properly, the net savings for April would have been at least 0.27 million Btu.

III. ACTION STATUS

The system contractor is aware of the existing control problems. However, it is not known at the present time what action will be taken to correct them prior to the start of the next heating season.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL,1979

SITE/SYSTEM DESCRIPTION:
THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 4400 SQ.FT. OFFICE SUITE. THIS IS ACCOMPLISHED BY CIRCULATING WATER THROUGH 53 FLAT PLATE COLLECTORS TO TRANSFER SOLAR ENERGY TO A 5000 GAL, UNDERGROUND TANK. THE DOMESTIC HOT WATER SUBSYSTEM IS AUGMENTED BY A 4.5 KW WATER HEATER WHEREAS THE SPACE HEATING SUBSYSTEM IS AUGMENTED BY A 36 KW DUCT HEATER AND A 10 TON HEAT PUMP.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	40.762	MILLION BTU
	42728	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	6.419	MILLION BTU
	6728	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	66	DEGREES F
AVERAGE BUILDING TEMPERATURE	73	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.05	
ECSS OPERATING ENERGY	0.230	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	1.001	MILLION BTU
TOTAL ENERGY CONSUMED	8.055	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.000	3.547	N.A.	3.547 MILLION BTU
SOLAR FRACTION	0	52	N.A.	52 PERCENT
SOLAR ENERGY USED	0.000	1.853	N.A.	1.853 MILLION BTU
OPERATING ENERGY	N.A.	0.771	N.A.	1.001 MILLION BTU
AUX. THERMAL ENERGY	0.000	0.445	N.A.	0.445 MILLION BTU
AUX. ELECTRIC FUEL	0.000	0.635	N.A.	0.635 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	0.000	0.104	N.A.	-0.126 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.651

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: BLAKEDALE PROF. CENTER GREENWOOD, S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL, 1979

SITE/SYSTEM DESCRIPTION:
THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 4400 SQ.FT. OFFICE SUITE. THIS IS ACCOMPLISHED BY CIRCULATING WATER THROUGH 53 FLAT PLATE COLLECTORS TO TRANSFER SOLAR ENERGY TO A 5000 GAL, UNDERGROUND TANK. THE DOMESTIC HOT WATER SUBSYSTEM IS AUGMENTED BY A 4.5 KW WATER HEATER WHEREAS THE SPACE HEATING SUBSYSTEM IS AUGMENTED BY A 36 KW DUCT HEATER AND A 10 TON HEAT PUMP.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	43.004 GIGA JOULES
	485216 KJ/SQ.M.
COLLECTED SOLAR ENERGY	6.772 GIGA JOULES
	76407 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	19 DEGREES C
AVERAGE BUILDING TEMPERATURE	23 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.05
ECSS OPERATING ENERGY	0.243 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	1.056 GIGA JOULES
TOTAL ENERGY CONSUMED	8.498 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.000	3.742	N.A.	3.742 GIGA JOULES
SOLAR FRACTION	0	52	N.A.	52 PERCENT
SOLAR ENERGY USED	0.000	1.955	N.A.	1.955 GIGA JOULES
OPERATING ENERGY	N.A.	0.814	N.A.	1.056 GIGA JOULES
AUX. THERMAL ENG	0.000	0.469	N.A.	0.469 GIGA JOULES
AUX. ELECTRIC FUEL	0.000	0.670	N.A.	0.670 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	0.000	0.110	N.A.	-0.132 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.651

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM, FEBRUARY 28, 1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: BLAKEDALE PROF. CENTER GREENWOOD, S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	1.408	71	0.000		0.016		0.000
2	0.525	70	0.000		0.004		0.000
3	0.211	65	0.000		0.000		0.000
4	0.296	59	0.000		0.002		0.000
5	2.060	61	0.000		0.018		0.000
6	1.916	62	0.000		0.016		0.000
7	1.657	60	0.000		0.013		0.000
8	0.628	61	0.078		0.007		0.125
9	1.887	64	0.171		0.017		0.091
10	1.992	60	0.186		0.017		0.093
11	0.491	63	0.259		0.004		0.527
12	0.867	71	0.000		0.012		0.000
13	0.117	64	0.000		0.000		0.000
14	1.944	68	0.000		0.017		0.000
15	2.173	67	0.000		0.020		0.000
16	2.014	65	0.188		0.017		0.094
17	1.986	66	0.300		0.017		0.151
18	1.545	64	0.310		0.014		0.201
19	1.930	67	0.221		0.017		0.115
20	1.972	70	0.140		0.000		0.071
21	2.157	74	0.000		0.000		0.000
22	1.551	72	0.000		0.000		0.000
23	0.812	72	0.000		0.000		0.000
24	0.884	71	0.000		0.000		0.000
25	0.222	64	0.000		0.000		0.000
26	0.583	68	0.000		0.000		0.000
27	1.543	68	0.000		0.000		0.000
28	1.934	64	0.000		0.000		0.000
29	1.559	59	0.000		0.000		0.000
30	1.900	65	0.000		0.000		0.000
SUM	40.762	-	1.853	N.A.	0.230	N.A.	-
AVG	1.359	66	0.062	N.A.	0.008	N.A.	0.045
NBS ID	0001	N113			Q102		N111

NOT APPLICABLE

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	1.408	1.020	0.313	79	0.222
2	0.525	0.000	0.000	75	0.000
3	0.211	0.000	0.000	*	0.000
4	0.296	0.061	-0.014	61	-0.046
5	2.060	1.947	0.575	72	0.279
6	1.916	1.772	0.475	*	0.248
7	1.657	1.471	0.364	*	0.220
8	0.628	0.297	-0.024	71	-0.038
9	1.887	1.751	0.615	76	0.326
10	1.992	1.861	0.615	*	0.309
11	0.491	0.250	0.031	69	0.062
12	0.867	0.731	0.139	80	0.161
13	0.117	0.000	0.000	65	0.000
14	1.944	1.825	0.587	78	0.302
15	2.173	2.034	0.646	80	0.297
16	2.014	1.874	0.657	78	0.326
17	1.986	2.334	0.538	78	0.271
18	1.545	1.268	0.352	*	0.228
19	1.930	1.797	0.550	79	0.285
20	1.972	0.000	0.000	84	0.000
21	2.157	0.000	0.000	84	0.000
22	1.551	0.000	0.000	83	0.000
23	0.812	0.000	0.000	79	0.000
24	0.884	0.000	0.000	79	0.000
25	0.222	0.000	0.000	66	0.000
26	0.583	0.000	0.000	*	0.000
27	1.543	0.000	0.000	*	0.000
28	1.934	0.000	0.000	75	0.000
29	1.559	0.000	0.000	68	0.000
30	1.900	0.000	0.000	79	0.000
SUM	40.762	22.294	6.419	-	-
AVG	1.359	0.743	0.214	76	0.157
NBSID	0001		0100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.311	0.000	0.250	110	0.804
2	0.000	0.000	-0.103	112	1.000
3	0.000	0.000	-0.076	110	1.000
4	-0.052	0.000	-0.139	108	2.681
5	0.553	0.000	0.481	110	0.870
6	0.458	0.000	0.359	121	0.784
7	0.324	0.000	0.472	128	1.457
8	-0.046	0.097	-0.663	128	12.268
9	0.544	0.240	0.084	117	0.596
10	0.607	0.241	0.087	120	0.541
11	0.027	0.313	-0.366	117	-1.963
12	0.100	0.069	-0.041	113	0.288
13	0.000	0.068	-0.196	110	1.000
14	0.555	0.067	0.348	111	0.748
15	0.622	0.067	0.322	120	0.625
16	0.638	0.271	0.187	125	0.718
17	0.528	0.363	0.000	127	0.687
18	0.328	0.360	-0.005	127	1.083
19	0.505	0.286	0.049	128	0.663
20	0.000	0.175	-0.246	126	1.000
21	0.000	0.000	-0.068	123	1.000
22	0.000	0.000	-0.035	122	1.000
23	0.000	0.000	-0.051	121	1.000
24	0.000	0.000	-0.068	119	1.000
25	0.000	0.000	-0.068	118	1.000
26	0.000	0.000	-0.079	116	1.000
27	0.000	0.000	-0.046	114	1.000
28	0.000	0.000	-0.076	113	1.000
29	0.000	0.000	-0.049	111	1.000
30	0.000	0.000	-0.052	110	1.000
SUM	6.001	2.617	0.211	-	-
AVG	0.200	0.087	0.007	118	0.471
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: BLAKEDALE PROF. CENTER GREENWOOD, S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL,1979

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.000	0	0.000	NOT APPLICABLE	0.000	0.000	NOT APPLICABLE	0.000	NOT APPLICABLE	64	64	0
2	0.000	0	0.000		0.000	0.000		0.000		64	64	0
3	0.000	0	0.000		0.000	0.000		0.000		64	64	0
4	0.000	0	0.000		0.000	0.000		0.000		64	64	0
5	0.000	0	0.000		0.000	0.000		0.000		64	64	0
6	0.000	0	0.000		0.000	0.000		0.000		64	64	0
7	0.000	0	0.000		0.000	0.000		0.000		64	64	0
8	0.000	0	0.000		0.000	0.000		0.000		64	64	0
9	0.000	0	0.000		0.000	0.000		0.000		64	64	0
10	0.000	0	0.000		0.000	0.000		0.000		64	64	0
11	0.000	0	0.000		0.000	0.000		0.000		64	64	0
12	0.000	0	0.000		0.000	0.000		0.000		64	64	0
13	0.000	0	0.000		0.000	0.000		0.000		64	64	0
14	0.000	0	0.000		0.000	0.000		0.000		64	64	0
15	0.000	0	0.000		0.000	0.000		0.000		64	64	0
16	0.000	0	0.000		0.000	0.000		0.000		64	64	0
17	0.000	0	0.000		0.000	0.000		0.000		64	64	0
18	0.000	0	0.000		0.000	0.000		0.000		64	64	0
19	0.000	0	0.000		0.000	0.000		0.000		64	64	0
20	0.000	0	0.000		0.000	0.000		0.000		64	64	0
21	0.000	0	0.000		0.000	0.000		0.000		64	64	0
22	0.000	0	0.000		0.000	0.000		0.000		64	64	0
23	0.000	0	0.000		0.000	0.000		0.000		64	64	0
24	0.000	0	0.000		0.000	0.000		0.000		64	64	0
25	0.000	0	0.000		0.000	0.000		0.000		64	64	0
26	0.000	0	0.000		0.000	0.000		0.000		64	64	0
27	0.000	0	0.000		0.000	0.000		0.000		64	64	0
28	0.000	0	0.000		0.000	0.000		0.000		64	64	0
29	0.000	0	0.000		0.000	0.000		0.000		64	64	0
30	0.000	0	0.000		0.000	0.000		0.000		64	64	0
SUM	0.000	-	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	-	-	0
AVG	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	64	64	0
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: BLAKEDALE PROF. CENTER GREENWOOD, S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL, 1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR. OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.000	0	0.000	0.000	0.000	0.000	N	0.000	N	74	71
2	0.029	0	0.000	0.002	0.007	0.010	O	0.000	O	75	70
3	0.000	0	0.000	0.001	0.000	0.000	T	0.000	T	74	65
4	0.149	0	0.000	0.026	0.040	0.057		0.000		73	59
5	0.229	0	0.000	0.019	0.061	0.087	A	0.000	A	73	61
6	0.339	0	0.000	0.023	0.086	0.124	P	0.000	P	72	62
7	0.000	0	0.000	0.000	0.000	0.000	P	0.000	P	68	60
8	0.078	101	0.078	0.020	0.000	0.000	L	0.010	L	71	61
9	0.208	82	0.171	0.056	0.011	0.015	I	0.010	I	74	64
10	0.444	42	0.186	0.071	0.070	0.099	C	0.024	C	74	60
11	0.259	100	0.259	0.057	0.000	0.000	A	0.044	A	74	63
12	0.000	0	0.000	0.039	0.000	0.000	B	-0.039	B	75	71
13	0.003	0	0.000	0.057	0.002	0.003	L	-0.058	L	75	64
14	0.000	0	0.000	0.039	0.000	0.000	E	-0.039	E	73	68
15	0.000	0	0.000	0.039	0.000	0.000		-0.039		71	67
16	0.317	59	0.188	0.060	0.031	0.044		0.025		74	65
17	0.334	90	0.300	0.060	0.010	0.015		0.059		75	66
18	0.351	88	0.310	0.061	0.010	0.015		0.064		75	64
19	0.264	84	0.221	0.073	0.011	0.015		0.017		74	67
20	0.166	85	0.140	0.030	0.006	0.009		0.027		75	70
21	0.000	0	0.000	0.000	0.000	0.000		0.000		74	74
22	0.000	0	0.000	0.000	0.000	0.000		0.000		73	72
23	0.000	0	0.000	0.001	0.000	0.000		0.000		75	72
24	0.000	0	0.000	0.000	0.000	0.000		0.000		75	71
25	0.028	0	0.000	0.012	0.009	0.013		0.000		74	64
26	0.000	0	0.000	0.000	0.000	0.000		0.000		75	68
27	0.000	0	0.000	0.001	0.000	0.000		0.000		74	68
28	0.000	0	0.000	0.000	0.000	0.000		0.000		71	64
29	0.080	0	0.000	0.006	0.021	0.029		0.000		69	59
30	0.268	0	0.000	0.021	0.069	0.099		0.000		72	65
SUM	3.547	-	1.853	0.771	0.445	0.635	N.A.	0.104	N.A.	-	-
AVG	0.118	52	0.062	0.026	0.015	0.021	N.A.	0.003	N.A.	73	66
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: BLAKEDALE PROF. CENTER GREENWOOD, S.C. SOLAR/2014-79/04
REPORT PERIOD: APRIL, 1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1476	N	71	79	N	N	N
2	550	O	70	75	O	O	O
3	221	T	65	*	T	T	T
4	310		59	61			
5	2160	A	61	72	A	A	A
6	2009	P	62	*	P	P	P
7	1737	P	60	*	P	P	P
8	658	L	61	71	L	L	L
9	1978	I	64	76	I	I	I
10	2088	C	60	*	C	C	C
11	514	A	63	69	A	A	A
12	908	B	71	80	B	B	B
13	123	L	64	65	L	L	L
14	2038	E	68	78	E	E	E
15	2278		67	80			
16	2111		65	78			
17	2082		66	78			
18	1619		64	*			
19	2023		67	79			
20	2067		70	84			
21	2261		74	84			
22	1626		72	83			
23	851		72	79			
24	926		71	79			
25	233		64	66			
26	612		68	*			
27	1617		68	*			
28	2027		64	75			
29	1635		59	68			
30	1991		65	79			
SUM	42728	N.A.	-	-	-	-	-
AVG	1424	N.A.	66	76	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

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